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SECONDARY CLOSURE OF WOUNDS

LT. GEORGE CRILE, M.C., U.S.N.R.

In the Naval Hospital at Auckland, New Zealand, the most common operation was the secondary closure of wounds. The majority of the wounded evacuated through this hospital from the Guadalcanal and New Georgia campaigns had open wounds when they arrived. Convalescence was often materially shortened and disability minimized by closing these wounds. I believe that the same principles can well be applied to wounds and injuries seen in civilian practice.

INDICATIONS FOR SECONDARY CLOSURE

The rate of healing of wounds varies greatly and does not appear to be related either to gross infection or to vitamin C deficiency. Moreover, the factors which influence the rapidity with which a wound closes of its own accord have not been determined.

Wounds close by contraction and by epithelization. These processes proceed at different speeds in different persons and in wounds of the same size in different locations. Wounds of the leg, particularly over the tibia, and wounds about the hip usually close slowly. An underlying bone, such as the tibia, seemingly interferes with contraction and with the blood supply necessary for growth of epithelium. Difficulty in immobilizing the hip without using a body cast may be responsible for failure of wounds about the hip to heal.

The size of a wound does not necessarily determine the advisability of closing it. In general, a wound over 2 inches in diameter should be closed, although occasionally it contracts and epi helizes so fast that spontaneous healing is nearly as rapid as the development of solid union after closure. However, a wound only 0.5 inch in diameter may reach complete equilibrium in which no further contraction or epithelization takes place. This phenomenon is usually encountered in wounds over the tibia, but may occur in any wound of long duration when a base of dense scar tissue limits the blood supply and ability to contract.

Since at first glance it is impossible to tell from the rapidity of healing whether closure is desirable, the wound should be observed for a week before advising closure. During this time any residual infection can be

The opinions or assertions contained herein are the private ones of the writer and not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large.

cleared up so that operation can be done in as clean a field as possible. Many fresh wounds which at first seem to require closure heal so fast during the period of preparation that operation is no longer necessary.

On the other hand, if a small wound, even 0.5 inch or less in diameter, reaches a stage when the edges appear totally inactive, when it is no longer closing by contraction and has remained the same size for a week or more, much time will be saved if a secondary closure is done without delay. Only by observing the wound and noting lack of progress under adequate conservative treatment can the time for closure be determined. Similarly, a wound which has been totally inactive may suddenly start to close and heal with miraculous celerity.

In general, the maximum healing tendency is not indicated until two weeks after the wound has been sustained. By this time the infection usually has subsided, and the wound is granulating cleanly and beginning to contract and epithelize. However, a wound which is two or more months old will exhibit no dramatic healing tendency and often develops the chronicity of an ulcer. It is a good rule, therefore, to close an old wound promptly and to delay in closing a small wound of recent origin. Large fresh wounds heal in accordance with the law of diminishing return: the wound may heal rapidly at first, and then, as scar tissue forms at the base and impedes circulation and contraction, the wound heals more slowly or may never heal. Thus it is unwise to expect the rapid spontaneous closure of a large wound, no matter how fast at first it may appear to be closing.

SECONDARY CLOSURE VS. SKIN GRAFTS OR SPONTANEOUS EPITHELIZATION

Whenever possible, closure of a defect by suture is preferable to the grafting of skin. After a closure the surface is composed of normal skin and subcutaneous tissue and is much more resistant to trauma than even a thick skin graft. Scarring is minimal, and unless there is injury to deeper tissues, the patient is fit to return to duty as soon as the wound is solidly healed.

A skin graft, however, must be protected from trauma for weeks or even months and, in areas subjected to weight-bearing or trauma, may never afford an entirely satisfactory surface.

In a large wound extensive scarring from spontaneous epithelization is similarly undesirable. The epithelium is thin and lacks the supportive

structures of normal skin. This type of epithelium may break down repeatedly from the slightest trauma, and if the scar is at the site of a joint, contracture may limit motion. Secondary closure, therefore, is the treatment of choice of all wounds which might heal with a broad scar that might be the site of future trouble.

It is difficult to determine when to graft skin and when to close a wound by suture. Usually, the skin defect is more apparent than real. The same elasticity of the skin which causes wide separation of the wound edges, especially after radical debridement of the wound, allows the wound to be closed again by suture.

However, when large amounts of skin are actually missing, as in a wound of exit when skin has been avulsed by shell fragments, or when primary closures have broken down with loss of skin edges, the defect may be too large to close without grafting. When this is true, grafting should be deferred until the wound is clean and until all sinuses have filled. After suitable preparation of the surface, a split skin graft should be applied.

The success of secondary closure depends largely upon the ability of the surgeon to immobilize the part and to apply an effective pressure dressing to the wound. When a snug pressure dressing can be applied by a circular elastic bandage, wounds of the arms or legs can be closed even under considerable tension. Wounds about the hip, however, are subject to motion with every movement of the trunk or legs unless a spica cast is used. If there is much tension in an area subjected to motion, the sutures tend to cut through and the wound edges tend to separate, resulting in a failure of the closure. Moreover, pressure is difficult to apply to wounds about the hip. Consequently, although wounds of the legs or arms may be closed under extreme tension, wounds of the hip should be grafted unless they can be brought together with ease.

Wounds of the muscular portions of the legs or arms can be undercut widely so that the edges can be approximated and firm pressure dressing can be applied without danger of interference with the circulation of the skin flaps. Wounds over the tibia, however, must be treated more carefully, for if flaps are widely undermined, the pressure of the dressing against the tibia may cut off the circulation and cause necrosis of the skin edges.

Similarly, when a flap is to be swung from the side of the leg over the tibia, it should first be elevated and then replaced in its bed for a week before effecting final transfer. The circulation of the skin is not so good in the leg as elsewhere, and when flaps are longer than the width of the bases, it is safer to transfer them in stages.

TECHNIC OF SECONDARY CLOSURE

If a defect is to be covered with a skin graft, the surface should be as clean and the granulations as healthy as possible. However, it is not so important that the granulations be flat and red if the wound is to be closed as it is if a graft is to be applied. Although a closure usually can be accomplished successfully even in the presence of considerable discharge, there should be no unclosed sinus tract leading to a pocket from which infection can spread to the entire wound.

Preparation for secondary closure of a clean granulating wound usually consists of sprinkling sulfanilamide powder on the wound twice daily for two days and of applying a pressure dressing saturated with azochloramide solution.

The operation is performed either under local anesthesia or under pentothal and consists of the following steps.

1. Granulation and scar tissues are excised down to normal muscle or fat. When nerves, vessels, tendons, or other important structures are in the vicinity, only the granulations are shaved away. Although it is my impression that the results are better when scar tissue is completely excised, there are not enough failures to warrant the risk of damaging important structures.

2. The skin is undercut sufficiently to accomplish a satisfactory closure.

3. Hemostasis is obtained chiefly by a pressure dressing, no attention being paid to venous or capillary oozing. Spurting arteries are ligated with No. 50 or No. 60 cotton. No catgut is used because of its tendency to cause reaction in the tissues with the resultant development of infection. Few or no ligatures are used. In my experience cotton is not discharged from these wounds.

4. The entire wound is dusted with sulfanilamide powder.

5. The skin edges are approximated with vertical mattress sutures of No. 32 stainless steel wire taking large bites. No rubber gauze nor other material is placed between the loops of the sutures and the skin to prevent the wires from cutting through. The wire with the aid of a pressure dressing holds the skin together long enough to insure adherence of the edges, and then, if the wire does cut through, only small vertical slits are left instead of large areas of necrosis from pressure of the material designed to keep the wire from cutting. Moreover, the circulation of the skin edges is not jeopardized by pressure from broad pieces of rubber under the wire loops. In short, it seems preferable in wounds closed under extreme tension to accept the cutting through of a small loop of the suture rather than to jeopardize the circu-

lation of the entire edge of the wound by pressure from various devices designed to prevent the sutures from cutting.

6. In the presence of considerable oozing or gross contamination, a small rubber drain is inserted through the skin edges at the dependent part of the wound.

7. A gauze dressing is applied to the wound, and over this, sterile mechanic's waste (cotton) is placed to assure an even distribution of pressure. Pressure is then applied with a woven elastic bandage.

8. If the wound involves a joint, the joint is splinted to insure absolute immobility.

9. The wound is inspected for infection after five days, and if it is healing well, the pressure dressings and splint are reapplied. The sutures are not removed for two or three weeks, even if they tend to cut partially through the tissues. The incidence of infection in these cases is low, and the results are good when pressure and immobilization can be attained, even when the wounds are closed under great tension.

SUMMARY

The effective secondary closure of wounds shortens the duration of convalescence and minimizes deformity from contracture of wounds. Whenever possible, closure of a defect by suture is preferable to the grafting of skin.

CHRONIC LARYNGEAL STENOSIS

Report of a Case Treated by Skin Grafting

PAUL M. MOORE, M.D.

Chronic laryngeal stenosis is a diminution in the size of the airway through the larynx, due to formation of scar tissue and adhesions in the larynx as a result of trauma or disease. The same condition may occur immediately below the larynx in the upper end of the trachea. According to Chevalier Jackson[1] 75 to 85 per cent of his cases are the result of high tracheotomy. For years he and his many followers have emphasized the importance of placing the tracheotomy tube as low in the neck, and consequently as far from the laryngeal structures, as possible. If circumstances should demand a fairly high emergency tracheotomy, this should be changed to a low tracheotomy as soon as the patient can reach a properly equipped operating room. Even in a dire emergency, however, one can make the opening in the trachea well below the danger level

by using Jackson's technic. Other traumatic causes are external injuries and wounds of the larynx and the effect of unrecognized foreign bodies in the larynx. Chronic laryngeal stenosis may also be produced by ulcerative laryngitis, diphtheria, perichondritis, syphilis, or tuberculosis.

At one time treatment entailed repeated and more or less forceful dilatations over a prolonged period of time. Unless the dilatations were continued, the dilated lumen subsequently contracted to its former inadequate size. The patient was forced to continue wearing a tracheotomy tube.[2,3]

The endolaryngeal method was greatly advanced by the development of the soft rubber, core molds of Jackson.[1,4] Even this required a long period of treatment and repeated changes to a larger size until the desired result was obtained.

Laryngostomy and tracheostomy with excision of the offending scar tissue gained in importance after Schmiegelow[5] combined it with placement of an India rubber drain within the involved area. The drain was anchored by transfixing the larynx and drain with a silver wire. The neck wound was then closed, and after weeks or months the drain and wire were removed through the mouth by direct laryngoscopy.

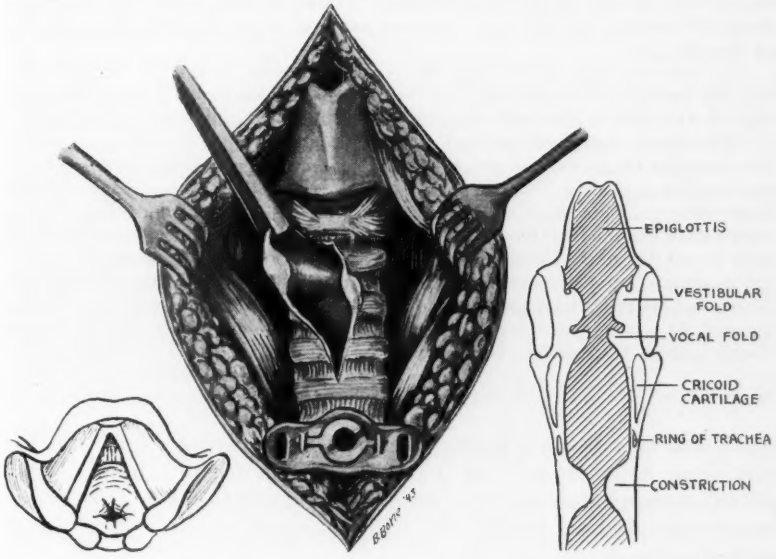
The greatest progressive step, however, was made by Arbuckle[6,7] when he combined the external operation and excision of scar tissue with the placement of a skin graft over the denuded area. This materially shortened the duration of treatment, obviated repeated manipulations, and produced a permanent recovery. Figi[8,9] modified Arbuckle's method, and it was his procedure which was followed in the case reported.

CASE REPORT

History. A white man, aged 27, was first seen on December 19, 1941. He gave a history of multiple papillomata from the age of 3. At the age of 5 a tracheotomy was done, and he wore the tracheotomy tube for a number of years. The last removal of a papilloma was at the age of 16, and at approximately the same time the tracheotomy tube was removed. He had no trouble until six weeks before consultation. At that time he had a slight cold, sore throat, and laryngitis. This persisted, and two weeks after onset he felt something "give" in his throat during a severe paroxysm of coughing. He coughed up a little blood-tinged sputum and became severely dyspneic. Afterward, he had recurrent episodes of coughing and marked dyspnea and was unable to work. Between episodes his breathing was fairly good, but he noted progressive weakness and loss of appetite and weight.

Physical examination. Examination showed a thin white man weighing 120 pounds. Blood pressure was 140 systolic and 90 diastolic. The lung fields were clear on auscultation and x-ray examination. There was a severe respiratory stridor. The nasal septum was deviated to the right causing partial obstruction. The nasal passages were

normal otherwise, and the sinuses were clear to transillumination. Nasopharynx and ears were normal. The faucial tonsils were small and buried. The crypts contained débris. Mirror laryngoscopy showed a small web between the vocal cords anteriorly. The left cord was somewhat injected, but both cords were smooth and moved normally. The subglottic region was not well visualized.



Operation. On December 20, 1941 a direct laryngoscopy was performed, and a stenosis of the larynx was found in the subglottic region. The airway was very small and situated posteriorly. A piece of tough scar tissue was removed for biopsy and the airway enlarged anteriorly by electrocoagulation. The tissue removed showed scar tissue covered with normal tracheal mucosa and no evidence of a new growth.

On December 29 another direct laryngoscopy was done. At this time the airway was large enough for a 3.5 mm. bronchoscope to be passed. This was followed by a 4 mm. bronchoscope. The tracheobronchial tree was normal below the stenosis. The stenotic area was again subjected to electrocoagulation.

The stenosis re-formed, however, and a tracheostomy was performed on February 17, 1942, under avertin-ether anesthesia. A midline incision was made from the thyroid cartilage to the suprasternal notch and carried down to the anterior tracheal wall by sharp and blunt dissection. The opening for the tracheotomy was made below the previous opening and as low in the neck as possible. A longitudinal incision was then made through the trachea from the cricoid cartilage down to the tracheal ring just above the new tracheotomy opening, thus leaving a bridge of cartilage above the tracheotomy tube to hold it in place. A diaphragm of dense scar tissue about 1 cm. thick was found just below the level of the cricoid cartilage. This was attached to the anterior and lateral walls. The posterior wall where the opening in the diaphragm was located was normal. The cartilaginous framework of the larynx and trachea was not deformed. The scar

tissue was removed by sharp dissection. A mold of air-foam rubber was cut to fit the trachea. A Thiersch graft from the left upper arm was wrapped around it and fastened with silk sutures as advised by Figi. This was then placed in the trachea so that it extended above and below the denuded area. The mold was then anchored to the tracheotomy tube with heavy linen thread. The wound was closed in layers. Through and through sutures were considered unnecessary, because the tracheotomy tube prevented the mold from slipping down, and the thread anchored to the tube kept it from slipping up into the glottis.

On the tenth postoperative day the thread anchor to the tracheotomy tube was cut, and the air-foam rubber mold was removed through the glottis by direct laryngoscopy. A 30 F. Jackson core mold was inserted and anchored to the tracheotomy tube.

The patient was discharged on the thirteenth postoperative day. Three days later (six days after the insertion of the core mold) he returned complaining bitterly of pain and inability to swallow. The core mold was removed by direct laryngoscopy. The air-foam rubber mold previously used with the skin graft was covered with the finger from a rubber glove and inserted through the laryngoscope. It was again anchored in place by a linen thread tied to the tracheotomy tube. When he was discharged two days later, he was swallowing normally and was quite comfortable. Three weeks later the mold was removed under direct laryngoscopy, and the following week the tracheotomy tube was removed. It is now almost two years since the tracheostomy. He has had no further trouble and has been working regularly for over a year.

SUMMARY

A case of subglottic laryngeal stenosis treated with excision of the scar tissue and skin grafting is presented. This technic eliminates repeated manipulations and shortens the period of treatment. The patient was hospitalized for fifteen days with complete recovery in a period of thirty-nine days.

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ANOMALOUS LESIONS OF THE UPPER URINARY TRACT

Report of Six Cases

ROBERT HUGHES, M.D., and B. H. NICHOLS, M.D.

Before the use of excretory urography and retrograde pyelography, anomalous lesions of the upper urinary tract were seldom diagnosed. In this paper we are presenting illustrated case histories of several of these anomalies, namely, ectopic kidney, fused kidney, solitary kidney, and ureteropelvic obstruction producing hydronephrosis. Some general concepts are applicable to anomalies of the upper urinary tract:

1. These anomalies are seldom suspected from the history or physical examination.
2. Urinary signs and symptoms may be absent.
3. Secondary complications are common.
4. These anomalies frequently produce referred abdominal symptoms ranging from vague dyspepsia and backache to symptoms of peptic ulcer, appendicitis, and gallbladder disease.
5. If not diagnosed before operation, these anomalies will complicate renal surgery.
6. Diagnosis is established by intravenous urography or retrograde pyelography.

The value of excretory urography cannot be overemphasized. It is a simple means of studying the urinary tract. The accuracy of diagnosis by this means depends on obtaining satisfactory roentgenograms and using a proper technic. Two general rules should be followed, namely, (1) no dye should be injected before a plain film of the abdomen is made, and (2) excretory urography should not be done within twenty-four hours of cystoscopy or catheterization of the ureters. Opaque shadows may be obscured, or false ones assumed, if a plain film is not available; irritability of the ureter and kidney from instrumentation can cause both to have an abnormal appearance. In exceptional instances a normal kidney may fail to visualize with urography, possibly because of hyperactive excretion of the dye or because of temporary dysfunction of the kidney. In contrast to retrograde pyelography, this study is widely applicable and, if more generally used, would result in the earlier diagnosis of many urological problems. Retrograde pyelography is frequently necessary to make or confirm the diagnosis, but should be reserved for the specialist.

Anomalous lesions of the upper urinary tract become urological problems if symptoms or complications develop. Any pathological con-

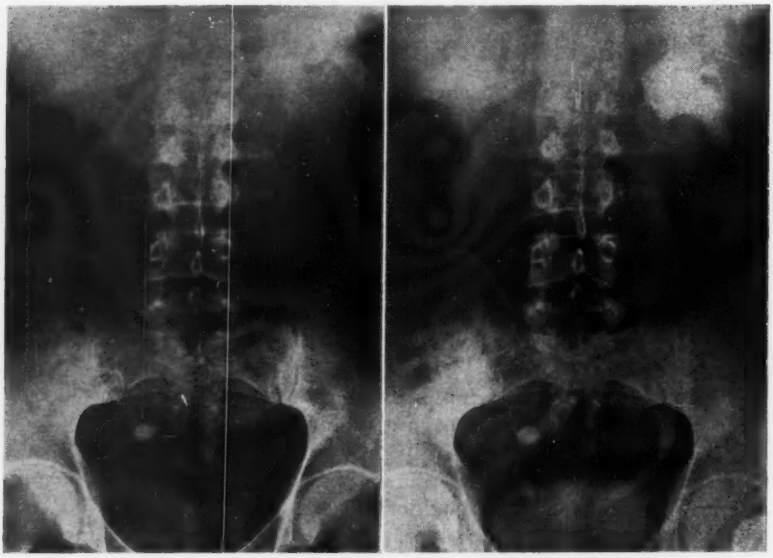

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FIG. 1 (**Case 1**) A—Plain roentgenogram of the abdomen showing a large calcification in the normal course of the right ureter.

B—Urogram demonstrating that this calcification is a large stone in an ectopic right kidney rather than a ureteral calculus. The congenital short ureter is well visualized.

dition that may occur in the normal kidney or ureter may develop in these anomalies. The more common complications are calculus formation, infection, and hydronephrosis.

ECTOPIC KIDNEYS

Ectopia is reported to occur once in every thousand autopsies and to account for 16.9 per cent of renal anomalies. It may occur as a unilateral or bilateral condition. Unilateral ectopic kidneys have been reported in many locations, such as between the crura of the diaphragm, between the layers of the mesosigmoid or broad ligament, and between the uterus and rectum. In cases of crossed ectopia the involved kidney lies below the normal one to which it may be fused.

The abnormal position of ectopic kidneys tends to interfere with the drainage of urine. This predisposes such anomalies to disease. Without disease, however, they may cause referred pressure pain or complicate pregnancy.

In the diagnosis a congenital short ureter is an important finding and serves to distinguish an ectopic kidney from a ptosed kidney.

Case 1. (4-18-39) A man, aged 38, gave a history of pain in the right side in 1923, for which appendectomy was done. Pain recurred in 1926, at which time a routine roentgenogram of the abdomen demonstrated a calcification in the course of the lower right ureter. This was interpreted as being a ureteral calculus, and laparotomy was advised. The attempt to remove this stone at operation was unsuccessful. Despite this failure, the patient never reported any subsequent pain or other urinary symptoms. The calcification was again demonstrated on a routine roentgenogram made four years later.

In 1939 the patient entered the Clinic because of symptoms that were diagnosed as being due to neurocirculatory asthenia and hypometabolism. Because of the past history and presence of many white blood cells in the urine, intravenous urography was done. This study demonstrated that the calcification, previously considered in the ureter, was actually present in a hydronephrotic right pelvic kidney. Surgery was advised but refused.

Case 2. (3-21-40) A man, aged 50, had an appendectomy performed in 1912. At this operation a mass of undetermined origin was found in the right lower quadrant.

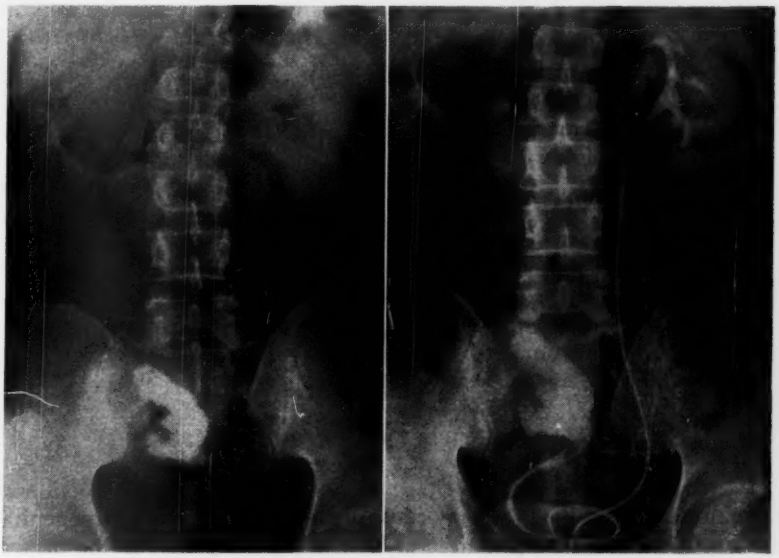

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FIG. 2 (Case 2) A—Plain roentgenogram showing a large staghorn type of calcification at the level of the right sacrum.

B—Pyelogram demonstrating this staghorn calcification in a hydronephrotic right ectopic kidney. The congenital short ureter is visualized.

He remained in good health until March, 1939 when he began to have recurrent attacks of dull pain in the lower right abdomen. There was no history of urinary symptoms.

He entered the Clinic in March, 1940 because of pain in the abdomen and neck and the finding of pus and blood in the urine. Examination at the Clinic revealed evidence of periarthritis and confirmed the report of white blood cells and red blood cells in the urine. Plain films and retrograde pyelography showed a large calculus in an ectopic right kidney. Nephrectomy was done. Two months later the patient was symptom free.

These two cases point out that symptoms resembling appendicitis may be caused by an ectopic kidney. The first case also demonstrates that a complete examination of the urinary tract is necessary before a positive diagnosis of ureteral calculus can be made.

In the differential diagnosis of ectopic kidney there are two helpful clinical signs, namely, the presence of an atypical pelvic or abdominal mass and the history of urinary symptoms. In these cases there was no information that either sign was elicited before appendectomy was done. In case 2 the finding of an unidentified mass in the right lower quadrant at operation should have led to subsequent intravenous urography or retrograde pyelography. By these studies a positive diagnosis of ectopia could have been established; and, in this instance, early diagnosis might have avoided subsequent nephrectomy.

In case 1 an attempt to make a positive diagnosis of ureteral calculus on the plain roentgenogram probably was responsible for the surgical complications. This wrong assumption emphasizes that the presence of any calcification in the course of the urinary tract is not adequate evidence for a positive diagnosis of stone. The presence and location of a calculus must be confirmed by intravenous urography or retrograde pyelography. These studies also provide additional information on the status of each kidney, without which elective surgery should not be done. In this case an incomplete examination of the urinary tract was most likely responsible for an unsuccessful operation.

URETEROPELVIC OBSTRUCTION

Anomalous lesions producing partial or intermittent obstruction at the ureteropelvic junction may cause a hydronephrosis. Such congenital lesions are strictures, periureteral bands, high insertion of the ureter, torsions, and aberrant vessels. Symptoms resulting from these anomalies usually appear in young persons. This diagnosis should be suspected in the presence of a hydronephrosis without apparent cause, especially if the ureter fails to visualize or is normal in size. The exact etiology of the

hydronephrosis is not evident on intravenous urography or retrograde pyelography and can only be determined at operation. The earlier these surgical lesions are suspected, the greater the opportunity for plastic repair. The results depend more on the degree of damage and infection in the kidney than on the type of anomaly.

One of the following cases illustrates a hydronephrosis due to stenosis or stricture at the ureteropelvic junction, and the other, hydronephrosis secondary to the presence of aberrant vessels.

Case 3. (9-2-42) A boy, aged 13, had intermittent dull pain in the left upper quadrant with occasional nausea and vomiting for three years. No urinary signs or symptoms were present except for a few red blood cells in the urine. Intravenous urography showed a left hydronephrosis. At operation the condition was found to be due to a stenosis at the ureteropelvic junction. Plastic repair was followed by postoperative dilations of the ureter. Routine investigation nine months later showed restoration of good kidney function and absence of symptoms.

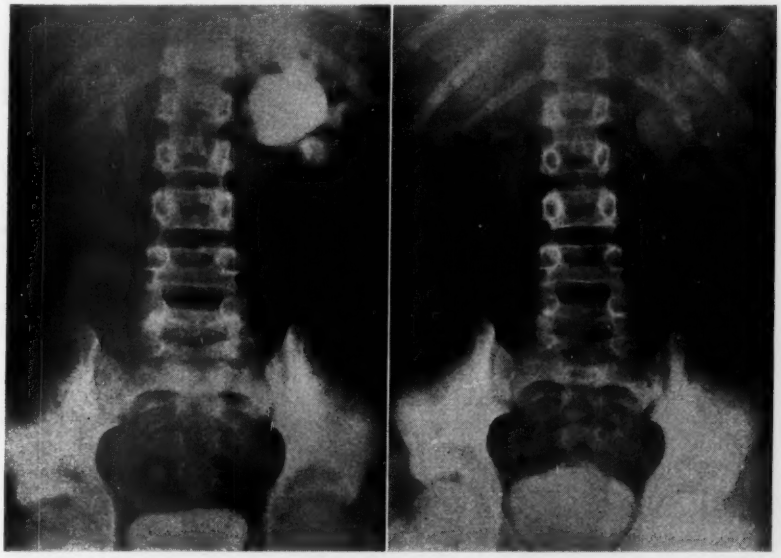

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FIG. 3 (**Case 3**) A—Urogram demonstrating a marked left hydronephrosis without visualization of the ureter. At operation the cause of obstruction at the ureteropelvic junction was found to be a congenital stenosis.

B—Urogram, after plastic operation on renal pelvis, showing good function in left kidney with marked decrease in amount of hydronephrosis. (Film made 45 minutes after intravenous dye, at which time the normal right kidney shows little residual diodrast.)

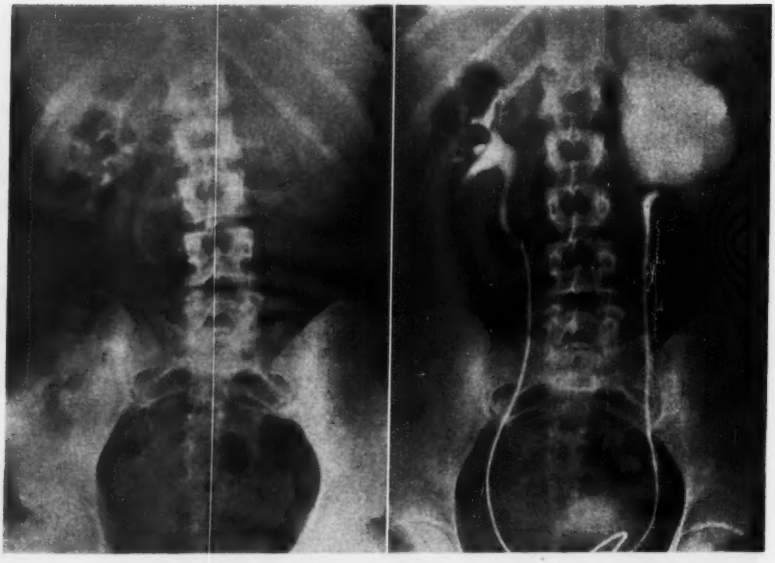

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FIG. 4 (**Case 4**) A—Urogram showing a nonfunctioning left kidney. The right kidney is partially obscured but normal.

B—Pyelogram revealing a huge left hydronephrosis. The left ureter contains some dye and appears normal in size. At operation the cause of obstruction at the ureteropelvic junction was found to be aberrant vessels. (The course of the upper left ureter demonstrated on the pyelogram suggested this possibility.)

Case 4. (8-18-42) A woman, aged 21, had intermittent attacks of severe pain in the left side for five years. This pain radiated to the abdomen and was frequently associated with nausea and vomiting. She had no urinary symptoms until gross hematuria occurred with a recent attack. Her family physician found a nonfunctioning left kidney on intravenous urography and referred the patient to the Clinic for further study.

The general examination and repeated urinanalyses were normal. Intravenous urography was repeated and confirmed the diagnosis of a nonfunctioning left kidney. Retrograde pyelography disclosed a huge left hydronephrosis due to obstruction at the ureteropelvic junction. At operation the cause was found to be aberrant vessels. Extensive kidney damage was present and necessitated nephrectomy. After operation, the patient was symptom free.

These two cases illustrate that hydronephrosis may develop with minimal symptoms or may produce atypical attacks of severe pain with or without urinary symptoms. The clinical picture of congenital hydronephrosis does not vary from that of acquired hydronephrosis; the symptoms may be referred to the gastrointestinal tract or resemble gallbladder disease in either case. The possibility of hydronephrosis should be considered in all patients having atypical abdominal distress.

FUSED KIDNEYS

Fused kidneys are reported to occur once in every 710 autopsies. They are the most common of all renal anomalies except for reduplication of the renal pelves. Fused kidneys are divided into two groups, the asymmetric and symmetric. The asymmetric type is rare and refers to such anomalies as unilateral fused kidneys or crossed ectopia with fusion. The symmetric, type, or horseshoe kidney, is common and shows fusion of the poles, usually the lower, by an isthmus of parenchymatous or fibrous tissue which crosses the lumbar spine. In this instance the fused organ is referred to as "sitting on the spine."

These renal anomalies are associated with abnormal arrangement of the pelves, ureters, and calices. The pelves are anterior; the ureters lie in front and usually cross the isthmus; the calices are not constant in position but tend to lie directed toward the midline.

Gutierrez,* in his monograph on horseshoe kidney, considered this anomaly an important clinical entity. He listed the symptoms as a

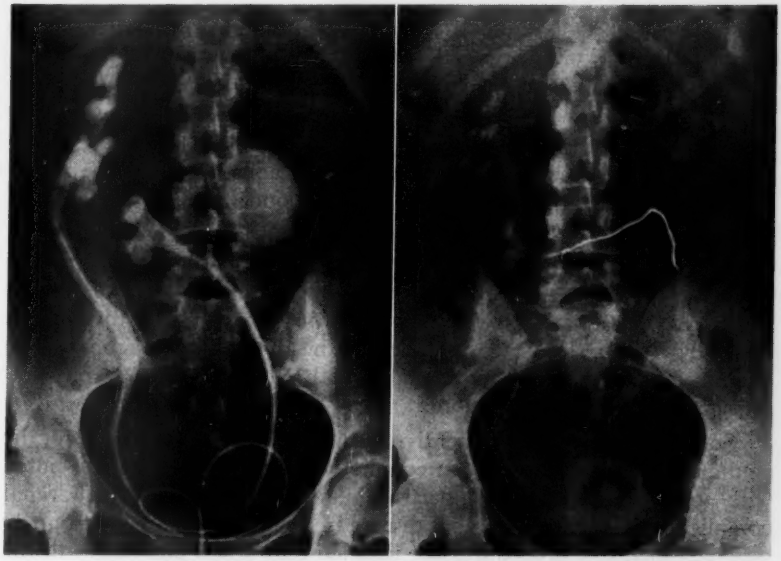

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FIG. 5 (Case 5) A—Pyelogram showing an asymmetric fused kidney. Marked hydronephrosis is demonstrated in one of the two pelves present in the left half of this kidney.

B—Urogram showing normal renal function after heminephrectomy and division of capsular fusion.

*Gutierrez, Robert: The Clinical Management of Horseshoe Kidney. (New York: Paul B Hoeber, 1934) p. 125.

syndrome: "(a) nephralgia or pain in the middle of the abdomen referred to the epigastrium or umbilical region; (b) gastrointestinal disorders with a long history of marked chronic constipation, and (c) long-standing intermittent attacks of urinary disturbances." These symptoms may likewise be present with an asymmetric fusion.

The case presented is of an asymmetric fused kidney with an anomalous bifid pelvis in the left half. The left kidney was further altered by marked hydronephrosis in one of the two pelves.

Case 5. (5-10-43) A woman, aged 25, had intermittent attacks of pain in the lower left back for the past five years. This pain was frequently associated with chills and fever, and occasionally with cloudy urine. There was no history of typical colic, frequency, or hematuria. Two years previously she went through pregnancy without developing any complications. After delivery, however, a mild attack of chills and fever occurred.

Examination at the Clinic revealed some tenderness and the suggestion of a mass in the midabdomen. Many white blood cells and a few red blood cells were found upon repeated urinalyses. Intravenous and retrograde pyelography showed an asymmetric fused kidney with the left half ectopic and lying in the midline. The left half showed a bifid pelvis with a marked hydronephrosis involving one of the two pelves. Dr. C. C. Higgins performed a heminephrectomy and removed the hydronephrotic portion of the left kidney. At operation both kidneys were found to be united by capsular fusion, which was severed. Follow-up two months later showed entirely satisfactory progress.

SOLITARY KIDNEYS

Solitary kidneys have been reported to constitute approximately 15 per cent of renal anomalies and to occur once in every 2500 births.

Solitary kidney means a complete or partial lack of development of the urinary tract on the affected side. The corresponding ureter, ureteral orifice, and trigone are usually absent along with the kidney. The fact that a part or all of the ureter may persist in the absence of the kidney, however, is important to remember in the differential diagnosis. The diagnosis of this anomaly requires that both intravenous urography and retrograde pyelography be done.

Solitary kidneys are frequently associated with malformations of the genital tract; rarely occupy an ectopic position; usually are associated with some compensatory hypertrophy; and are subject to all renal complications. It is obvious that disease in a solitary kidney is extremely serious. Operative procedures are justified only when planned with the knowledge that a single kidney is present. Despite these serious implications, this anomaly is consistent with normal health and an average span of life.

In the case reported here, a normal solitary kidney was discovered in a woman who had pelvic inflammatory disease.

Case 6. (8-25-43) A woman, aged 33, stated that she had a pelvic abscess on the right side, which was incised and drained seven years ago. The associated distress was never completely relieved by this operation. In the past year both the pain and pelvic mass recurred. Intravenous urography was done in the course of her examination and was interpreted as showing a nonfunctioning right kidney. There was no history of urinary symptoms.

The patient was referred to the Clinic for further investigation. The physical examination was normal except for confirming the presence of a mass in the right side of the pelvis. Urinalyses and blood urea determinations were normal. Intravenous urography was repeated and demonstrated a normal left kidney but showed no evidence of a right kidney or right ureter. Retrograde studies were then done and revealed an absence of the right ureteral orifice and right trigone. By correlating these findings, a positive diagnosis of an absent right kidney was made.

This patient was advised to have an exploratory laparotomy but operation was refused. The pelvic pathology was clinically considered inflammatory in character.

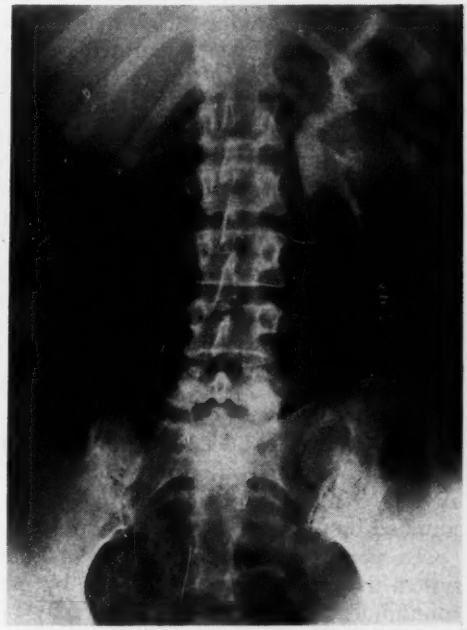


FIG. 6 (**Case 6**) Urogram showing a normal solitary left kidney. (The absence of the right kidney was confirmed at cystoscopy, which failed to show either the right ureteral orifice or right trigone.)

SUMMARY

1. Six cases of anomalous lesions in the upper urinary tract are presented.

2. These lesions become urological problems when symptoms or complications develop.

3. These anomalies may be misinterpreted as appendicitis, gastrointestinal disease, or gallbladder disease.

4. Surgical operations upon the kidney or ureter will be complicated if an anomaly is present.

5. Adequate investigation of the urinary tract must be made for accurate diagnosis.

PORENCEPHALIC CYST

Report of a Case

ALEXANDER T. BUNTS, M.D.

Porencephaly signifies a detect in brain structure, having the appearance of a cystlike cavity, which may communicate with the ventricular system or which may be separated from it by a thin membrane. Frequently, such defects are unaccompanied by clinical symptoms or signs during life and are usually first identified at autopsy or accidently at operation. The condition probably arises (1) as a true developmental aplasia or hypoplasia, or (2) as an acquired defect due to trauma, to encephalitis, or to circulatory disturbances, such as thrombosis or embolism, producing ischemic necrosis and resorption of brain tissue. According to Yakovlev and Wadsworth[1] true porencephaly results from arrest of development of the wall of the secondary cerebral vesicle during fetal life, with formation of a virtual cleft in the cerebral mantle. Such clefts are usually bilateral and symmetrical and do not conform to areas of specific vascular supply. On the other hand, the acquired types are usually single and unilateral, with borders usually showing evidence of old necrotic foci, gliosis, connective scar tissue, and meningeal thickening. The cyst is filled with fluid, which is usually colorless, and is covered by a thin layer of pia-arachnoid. The acquired types may occur anywhere in the cerebrum but are most commonly found in the area supplied by the middle cerebral artery.

In porencephalic cysts which communicate with the ventricular system the diagnosis may be made by pneumoencephalography. Noncommunicating cysts occasionally may be identified unexpectedly by ventriculography carried out for an entirely different diagnostic purpose. Such a case is the subject of this report.

This case is reported because of (1) the obscure clinical picture leading to an erroneous tentative diagnosis, (2) the presence of papilledema, and (3) the uncertain etiology of the cystic defect.

CASE REPORT

History. A white housewife, aged 50, first came to the Clinic on February 6, 1937. She had been married for thirty-three years and had two living children. There was no history of birth injury, febrile illness, head trauma, coma, convulsions, or paralysis prior to the onset of the present illness. She had mumps, measles, and chickenpox in childhood.

From 1934 to the summer of 1936 the patient experienced recurrent frontal "sick headaches" with nausea or vomiting about twice a week. These symptoms subsided al-

most completely and were succeeded by daily intermittent transient attacks of occipital pain, which radiated to the frontal area. These pains were sudden in onset, occurred usually in the morning, were severe and pounding in character, of short duration, and often caused the patient to scream. Sudden extension of the head usually preceded the onset of pain. During these bouts of pain the gait was somewhat unsteady. A daughter reported that the patient's memory seemed to be poor and that there had been some vague change in her personality. She worried constantly. Her vision became blurred during the month before she came to the Clinic.

Physical Examination. General physical examination revealed no signs of organic disease in the heart, lungs, or abdominal viscera. Blood pressure was 144 systolic and 98 diastolic. Neurologic examination revealed no motor, sensory, nor reflex abnormalities. The patient was rather apprehensive. Her gait was slightly unsteady. Romberg test was negative. Ophthalmoscopic examination showed a low-grade papilledema of less than 1 diopter in each eye. Examination of the visual fields revealed a moderate temporal field loss in the left eye, but no field loss in the right eye.

Blood studies indicated mild secondary anemia. Wassermann reaction was negative. Urinalysis was normal.

Roentgen examination of the skull disclosed erosion of the posterior clinoid processes suggestive of increased intracranial pressure. Films of the chest showed no abnormal changes.

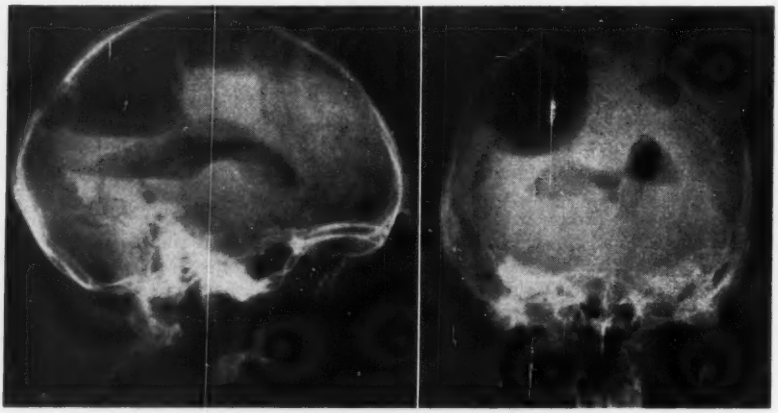
A tentative diagnosis of posterior fossa tumor was made, and a ventriculogram was proposed for the purpose of localizing the intracranial lesion.

Operation. February 12, 1937. With the patient under avertin anesthesia and in the upright position, two holes were drilled through the skull at points symmetrically located 3 cm. to each side of the midline and 6 cm. above the external occipital protuberance. A ventricular cannula was inserted into the posterior horn of the left lateral ventricle, which was encountered at a depth of 5 cm. Clear colorless fluid escaped under moderately increased pressure. A small opening was made in the dura on the right side, and a thin veil-like membrane bulged slightly through the dural opening. The dural opening was enlarged, and the thin bulging membrane was found to lie just beneath the dura. A cannula was inserted through the membrane, and clear colorless fluid escaped in large quantity (not measured) under increased pressure. One cc. of methylene blue dye was injected into the left lateral ventricle. The operator rotated the head for twenty minutes, and the dye failed to appear from the cannula on the right side, indicating absence of communication between the left lateral ventricle and the cavity in the right occipital lobe. Air was injected into the left lateral ventricle, the cannula was withdrawn, and the scalp incision was closed. Through the drill hole on the right side, the cavity was visually explored with the aid of a Cameron light and a ventriculoscope. The cavity appeared to be about the size of a tennis ball and to extend well forward from the occipital pole toward the frontal lobe. The inner surface of the large cavity appeared to be smooth, without convolutional structure, and numerous blood vessels coursed over it. No tumor nodule was found in the wall of the cavity. No choroid plexus was present, and no opening could be seen in the floor of the cavity. Air was injected into the cavity, and the scalp incision was closed. Total protein content of the fluid obtained from the left lateral ventricle was 15 mg. per 100 cc. The fluid from the cyst contained 175 mg. of total protein per 100 cc.

Ventriculograms, made in the usual positions, showed a large cystic cavity which occupied the greater part of the right occipital lobe and extended forward into the parietal lobe (fig. 1). The right lateral ventricle was depressed by the overlying cyst and dislocated toward the left side. The left lateral ventricle was moderately dilated, normal in

contour, and displaced slightly to the left. The right occipital cyst appeared to be separated from the roof of the right lateral ventricle only by a thin membrane.

After ventriculographic studies and evacuation of the cyst, further operation was not considered necessary. The patient was asked to return for observation, because the development of increased intracranial pressure might necessitate the establishment of a communication between the cyst and the right ventricle by an opening in the intervening membrane. The patient was last observed February 17, 1943, six years after ventriculography. Her general health was still good, although she continued to have headaches of moderate severity. Her vision was good, the margins of the optic discs were slightly hazy but not edematous, and the visual fields had not changed in six years. Lumbar pucture on that date showed a pressure of 120 mm. of water (normal); the fluid contained 30 mg. per 100 cc. of total protein.



FIGS. 1 and 2—Lateral and posteroanterior roentgenograms of the skull, after the introduction of air into the left lateral ventricle and into the right occipital porencephalic cyst, showing depression of the right lateral ventricle and dislocation of the midline toward the left side.

COMMENT

This cavity undoubtedly represented a porencephalic cyst, which produced symptoms and signs of increased intracranial pressure, including severe headaches and papilledema. The site of the lesion in the right occipital lobe was not suspected, and the few localizing symptoms suggested the possibility of a cerebellar lesion. In view of the extensive involvement of the right occipital lobe, it was surprising that there was no evidence of a well-defined left homonymous hemianopsia, but merely a slight partial temporal field loss in the left eye alone. Origin of the cyst was obscure, although the absence of symptoms prior to middle life, the unilaterality of the lesion, and the absence of communication with

the ventricle suggested an acquired lesion rather than a primary developmental aplasia.

It was particularly interesting that the total protein content of the cystic fluid was greatly increased (175 mg. per 100 cc.), and the total protein content of the fluid obtained from the left ventricle was normal (15 mg. per 100 cc.). This might account for the increased intracranial pressure, for there would tend to be a continuous slow passage of fluid by osmosis from the right lateral ventricle across the semipermeable membrane into the closed cyst cavity. Increased pressure within the cyst could result in downward dislocation of the right ventricle, and lateral dislocation of the posterior part of the third ventricle and of the upper part of the aqueduct. Thus the partial obstruction to the circulation of the cerebrospinal fluid could account for a moderate degree of increased intracranial pressure with low-grade papilledema.

This case presents many features of similarity with that reported by Love and Groff.[2] In their case a large right occipital porencephalic cyst was accompanied by increased intracranial pressure and symptoms suggestive of a cerebellar lesion. The fluid within the cyst was yellow and probably contained a large amount of protein. They established a communication between the cyst and the ventricle and thus relieved the increased intracranial pressure by destroying the osmotic mechanism.

Thus far in the case here reported, the patient's symptoms have not been troublesome nor severe enough to require such a procedure, although she will be carefully observed each year with such a possibility in mind.

SUMMARY

A case of porencephalic cyst is reported. An explanation is offered for the presence of increased intracranial pressure on the basis of osmosis between the ventricular fluid and the cystic fluid, with resultant partial obstruction to the flow of cerebrospinal fluid through the third ventricle and aqueduct.

REFERENCES

1. Yakovlev, P. I. and Wadsworth, R. C.: Double symmetrical porencephalies. Tr. Am. Neurol. A. 67:24, 1941.
2. Love, J. G. and Groff, J. E.: Porencephalic cyst: report of a case. Proc. Staff Meet., Mayo Clin. 14:709, 1939.

AN APPRAISAL OF THE WATER TEST OF ADRENAL FUNCTION

R. W. SCHNEIDER, M.D.

The water excretion test of adrenal function as described by Robinson, Power and Kepler[1] has been used in the diagnosis and exclusion of adrenal insufficiency. The test is made in two parts*. Part 1 consists of a comparison between the volume of urine excreted during the night and the largest volume of a single hourly specimen supplied in the forenoon. In the original description of the test it was stated that "if the volume of any single hourly specimen provided during the morning is greater than the volume of urine provided during the night, the response to the test is negative, that is, such a response indicates the absence of Addison's disease." It was further stated that if part 1 was negative, part 2 need not be carried out. However, in our study both parts of the test were completed in all instances regardless of the results obtained in part 1, principally because we wished to verify the findings advanced by Robinson, Power and Kepler.

In the 194 consecutive tests comprising this study the results obtained were divided into four groups. Group 1 included tests in which both parts gave negative results. Group 2 included tests in which part 1 was negative and part 2 positive. Group 3 included tests in which part 1

* Procedure 1: On the day before the test, the patient is instructed that the usual salt intake is neither to be restricted nor to be supplemented by additional salt tablets. He is to eat or drink nothing after 6 o'clock in the evening. Until this hour he may eat and drink as desired. At 10:30 p. m. he is required to empty his bladder and discard the urine. All urine voided from 10:30 p. m. until and including 7:30 a. m. is collected as the night specimen. The volume of the night specimen is determined and the urine saved for chemical analysis. Breakfast is omitted and fasting blood drawn for urea and chloride determination. At 8:30 a. m. the patient voids again, and the urine is discarded. Between 8:30 a. m. and 9:15 a. m. he is asked to drink a volume of water equal to 9 cc. per pound of body weight. At 9:30 a. m., 10:30 a. m., 11:30 a. m., and 12:30 p. m. he is requested to empty his bladder, each time in a separate container. The volume of the largest morning specimen is then measured. He is kept at rest during the morning period.

Procedure 2: The fasting plasma urea and chloride are determined in mg. per cent. The night volume of urine and the largest morning specimen of urine are measured in cc. The night urine specimen is analyzed for urea and chloride in mg. per cent. From these data the following equation is then solved.

$$X = \frac{\text{urea in urine (mg. per cent)}}{\text{urea in plasma (mg. per cent)}} \times \frac{\text{chloride in plasma (mg. per cent)}}{\text{chloride in urine (mg. per cent)}} \times \frac{\text{largest volume of day urine in cc.}}{\text{total volume of night urine in cc.}}$$

If X is greater than 30, the test is negative; if less than 25, the test is considered positive.

was positive and part 2 negative. Group 4 included tests in which both parts gave positive results.

Group 1—Part 1 and part 2 negative, 113 tests in 112 cases. In 111 of 112 patients the test gave negative results and assisted in the exclusion of adrenal insufficiency. In the remaining patient the results of the test were negative on two occasions. However, because the patient presented characteristic pigmentation and other clinical features of Addison's disease, the results of the water test were considered inadequate to exclude Addison's disease completely. All other tests of adrenal insufficiency including the Cutler-Power-Wilder salt deprivation test were also negative. Excretion of 17-ketosteroids in the urine was 7.8 mg. in the 24 hour period. The diagnosis of adrenal insufficiency therefore could not be substantiated except for the pigmentation and response to adrenal therapy. This case indicated that the water test was no less reliable than any other test of adrenal function.

Group 2—Part 1 negative and part 2 positive, 2 cases. In both cases the result in part 2 was incorrectly positive. One of these patients had a duodenal ulcer, pyloric obstruction, and loss of chlorides. The other had an elevated blood urea. In both instances these changes were sufficient to render the test positive. In no other instance in the series was evidence of adrenal insufficiency found by completing part 2 when the result of part 1 was negative.

Group 3—Part 1 positive and part 2 negative, 20 cases. The presence of adrenal insufficiency was excluded only after part 2 had been completed. The only feature common to these patients was fatigue or exhaustion of varying degree. Final diagnoses included anorexia nervosa, carcinoma of the stomach, chronic nervous exhaustion, hyperventilation tetany, and undulant fever. The test had value in excluding adrenal insufficiency as a cause of symptoms.

Group 4—Part 1 and part 2 positive, 59 tests in 39 cases. From the results of the test alone, all patients in this group were considered as having adrenal insufficiency.

Sixteen patients had proven Addison's disease. The diagnosis in all was substantiated by other tests of adrenal function and by the patient's response to replacement therapy.

In 12 patients the test gave presumptive evidence of adrenal failure of pituitary origin. Frank pituitary disease was present in each case. Two patients had acromegaly associated with enlargement of the sella turcica. In 8 cases neoplasm of the pituitary without acromegaly was associated with varying degrees of hypogonadism. One patient had a

Rathke pouch cyst. Another patient had pituitary cachexia as a result of surgical trauma to the anterior lobe of the pituitary.

Three cases were classified as miscellaneous adrenal disease. One patient had carcinoma of the adrenal cortex with a high titer of urinary 17-ketosteroids and hirsutism. One patient had the characteristic features of Cushing's syndrome. In the third case positive proof of an adrenal defect was lacking. This patient had generalized anasarca without measurable renal, cardiac, or nutritional factors. Chronic constrictive pericarditis, hypoproteinemia, chronic nephritis, and other conditions which might have been causing anasarca were excluded insofar as possible. After dehydration with a low-sodium high-potassium intake and mercupurin, the water excretion test became negative. We wondered if this excessive water retention was associated with an adrenal abnormality.

The 8 remaining patients giving positive results to the test were not considered to have adrenal insufficiency. Five had diseases not usually accepted as embodying adrenal failure. One of these had disseminated lupus erythematosus and marked cachexia. Two had generalized carcinomatosis and malnutrition. One had grade III rheumatoid arthritis and inanition. In a woman with renal tuberculosis the test was positive twice and negative once. Assays for 17-ketosteroid excretion were normal.

Two patients had duodenal ulcer with partial pyloric obstruction and vomiting, which apparently disturbed the water and chloride balance.

One positive test was the result of an error in technic, and upon repetition the test was negative.

COMMENT

In my experience the water excretion test of adrenal function is satisfactory and of definite value in the diagnosis and exclusion of adrenal insufficiency. The chief advantages are that it is safe, that a special diet is not a prerequisite, and that it does not require hospitalization. In these respects it offers an advantage over the Cutler-Power-Wilder test. The chief disadvantage is that in the absence of adrenal insufficiency other conditions such as renal disease, duodenal ulcer, and chronic cachexia may give a positive result. In such instances adrenal insufficiency must be excluded by the salt deprivation test, assays for 17-ketosteroids, and so forth.

In our experience the test is of little value in determining response to the treatment of adrenal insufficiency. In some instances the test has become negative following treatment, but in other instances with more intensive treatment, it has remained positive.